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Correlated Impurities in Diluted Magnetic Semiconductors: a disordered Heisenberg Model Monte Carlo study[1] D.J. PRIOUR, S. DAS SARMA, University of Maryland — We consider two types of correlated doping in $Ga_{1-x}Mn_xAs$, patterned doping (in which Mn impurities are deposited as a cubic superlattice) and impurity clustering (in which dopants adhere, forming clusters); calculations are via classical Monte Carlo with impurity moments modeled as Heisenberg spins interacting through the damped RKKY range function with the damping scale given by the carrier mean free path. We calculate Curie Temperatures T_c, magnetization, and magnetic susceptibility. In both the patterned and clustered doping schemes, the deviation from the superlattice structure or the degree of impurity cluster formation is continuously tunable. In agreement with lattice Mean Field Theory (MFT), Curie Temperatures increase with increasing deviation from a perfect impurity superlattice. However, in the clustering scheme, T_c is initially robust as clustering increases, ultimately decreasing slowly as impurities become strongly clumped; lattice MFT predicts instead that T_c rises as clustering becomes more prevalent. When impurity clumping is very extensive, clusters of spins act as isolated moments; calculations reveal that the resulting paramagnetic state has a magnetic susceptibility which is distinct from that of the (ferromagnetic) states in which Mn dopants are more weakly clustered.

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